What is claims is:

1. An optical characteristic measuring apparatus for measuring optical characteristic of a device under test, the apparatus comprising:

an entangled photon pair generating element for generating an entangled photon pair, and supplying said device under test with first light which is one of said entangled photon pair;

an optical path length changing element for changing at least one of an optical path of second light which is the other one of said entangled photon pair, and an optical path of said first light;

a quantum interfering element for transmitting and reflecting said first light transmitting through said device under test, transmitting and reflecting said second light, supplying first multiplexed light which is formed by multiplexing the reflected component of said first light and the transmitted component of said second light, and supplying second multiplexed light which is formed by multiplexing the transmitted component of said first light and the reflected component of said second light;

a photon detecting element for detecting a photon in said first multiplexed light and said second multiplexed light;

a photon simultaneous detection measuring element for measuring a quantity which changes when the photons are simultaneously detected by said photon detecting element; and

a characteristic measuring element for measuring the optical characteristic of said device under test based on the quantity measured by said

photon simultaneous detection measuring element.

2. The optical characteristic measuring apparatus according to claim 1, wherein:

said entangled photon pair generating element comprises:

a light source for signal for generating input signal light;

a light source for excitation for generating input excited light with a frequency higher than that of said input signal light; and

an optical parametric amplifier for receiving said input signal light and said input excited signal light, and generating signal light with a frequency equal to the frequency of said input signal light, and idler light with a frequency equal to the difference between the frequency of said input excited light and the frequency of said input signal light.

3. The optical characteristic measuring apparatus according to claim 1, wherein:

said entangled photon pair generating element comprises:

a light source for excitation for generating input excited light; and

a spontaneous parametric down-converting element for receiving said input excited light, and generating signal light and idler light.

4. The optical characteristic measuring apparatus according to claim 1, wherein said quantum interfering element is a semi-transparent mirror.

5. The optical characteristic measuring apparatus according to claim 1, wherein said quantum interfering element is a beam splitter.

6. The optical characteristic measuring apparatus according to claim 4 or 5, wherein:

the transmission optical paths from said entangled photon pair generating element, transmitting thorough said quantum interfering element, to said photon detecting element of said first light and said second light can be set equal, and

the reflection optical paths from said entangled photon pair generating element, reflected by said quantum interfering element, to said photon detecting element of said first light and said second light can differ from each other by a length sufficiently longer than the coherence length of the first light and the second light.

7. The optical characteristic measuring apparatus according to claim 1, wherein:

said photon detecting element comprises:

a first photon detecting element for detecting a photon of said first multiplexed light; and

a second photon detecting element for detecting a photon of said second multiplexed light.

8. The optical characteristic measuring apparatus according to claim 7, wherein:

said photon simultaneous detection measuring element comprises:

a simultaneous detection signal supplying element for supplying a simultaneous detection signal when said first photon detecting element and said second photon detecting element simultaneously detect photons; and

a counting element for counting the frequency of said simultaneous detection signal supplied from said simultaneous detection signal supplying element.

9. The optical characteristic measuring apparatus according to claim 1, wherein:

said photon detecting element comprises:

a third multiplexed light generating element for generating third multiplexed light by multiplexing said first multiplexed light and said second multiplexed light after changing the direction of polarization of the first multiplexed light or the second multiplexed light by 90 degrees; and

a simultaneous detection light supplying element for receiving said third multiplexed light, and supplying simultaneous detection light whose frequency is the sum of the frequency of said first multiplexed light and the frequency of said second multiplexed light when the first multiplexed light and the second multiplexed light simultaneously have high light intensity.

10. The optical characteristic measuring apparatus according to claim 9,

wherein:

said photon simultaneous detection measuring element comprises:

an optical filter for receiving the output from said simultaneous detection light supplying element, and transmitting the light having the frequency which is the sum of the frequency of said first multiplexed light and the frequency of said second multiplexed light;

a light detecting element for converting the light having transmitted through said optical filter into an electric signal; and

a voltage measuring element for measuring the voltage of said electric signal.

11. The optical characteristic measuring apparatus according to claim 1, wherein said characteristic measuring element measures the delay or the dispersion of said device under test.

12. The optical characteristic measuring apparatus according to claim 1, wherein said characteristic measuring element measures the attenuation constant of said device under test based on the quantity measured by said photon simultaneous detection measuring element when said first light is supplied for said device under test, and the quantity measured by said photon simultaneous detection measuring element when the first light is directly entered into said quantum interfering element.

13. The optical characteristic measuring apparatus according to claim 2,

wherein said characteristic measuring element measures a frequency characteristic of the dispersion in a region of a frequency dispersion with the phase matching frequency of said optical parametric amplifier as the center based on Fourier transform of the quantity measured by said photon simultaneous detection measuring element.

14. An optical characteristic measuring method for measuring optical characteristic of a device under test, the method comprising:

an entangled photon pair generating step for generating an entangled photon pair, and supplying said device under test with first light which is one of said entangled photon pair;

an optical path length changing step for changing at least one of an optical path of second light which is the other one of said entangled photon pair, and an optical path of said first light;

a quantum interfering step for transmitting and reflecting said first light transmitting through said device under test, transmitting and reflecting said second light, supplying first multiplexed light which is formed by multiplexing the reflected component of said first light and the transmitted component of said second light, and supplying second multiplexed light which is formed by multiplexing the transmitted component of said first light and the reflected component of said second light;

a photon detecting step for detecting a photon in said first multiplexed light and said second multiplexed light;

a photon simultaneous detection measuring step for measuring a

quantity which changes when the photons are simultaneously detected by said photon detecting step; and

a characteristic measuring step for measuring the optical characteristic of said device under test based on the quantity measured by said photon simultaneous detection measuring step.

15. A program of instructions for execution by the computer to perform an optical characteristic measuring process performed by an apparatus for measuring optical characteristic of a device under test comprising: an entangled photon pair generating element for generating an entangled photon pair, and supplying said device under test with first light which is one of said entangled photon pair; an optical path length changing element for changing at least one of an optical path of second light which is the other one of said entangled photon pair, and an optical path of said first light; a quantum interfering element for transmitting and reflecting said first light transmitting through said device under test, transmitting and reflecting said second light, supplying first multiplexed light which is formed by multiplexing the reflected component of said first light and the transmitted component of said second light, and supplying second multiplexed light which is formed by multiplexing the transmitted component of said first light and the reflected component of said second light; a photon detecting element for detecting a photon in said first multiplexed light and said second multiplexed light; and a photon simultaneous detection measuring element for measuring a quantity which changes when the photons are simultaneously detected by said photon detecting element,

the process comprising a characteristic measuring processing for measuring the optical characteristic of said device under test based on the quantity measured by said photon simultaneous detection measuring element.

16. A computer-readable medium having a program of instructions for execution by the computer to perform an optical characteristic measuring process performed by an apparatus for measuring optical characteristic of a device under test comprising: an entangled photon pair generating element for generating an entangled photon pair, and supplying said device under test with first light which is one of said entangled photon pair; an optical path length changing element for changing at least one of an optical path of second light which is the other one of said entangled photon pair, and an optical path of said first light; a quantum interfering element for transmitting and reflecting said first light transmitting through said device under test, transmitting and reflecting said second light, supplying first multiplexed light which is formed by multiplexing the reflected component of said first light and the transmitted component of said second light, and supplying second multiplexed light which is formed by multiplexing the transmitted component of said first light and the reflected component of said second light; a photon detecting element for detecting a photon in said first multiplexed light and said second multiplexed light; and a photon simultaneous detection measuring element for measuring a quantity which changes when the photons are simultaneously detected by said photon detecting element,

the process comprising a characteristic measuring processing for

measuring the optical characteristic of said device under test based on the quantity measured by said photon simultaneous detection measuring element.